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AN INVESTIGATION OF THE APPLICATION  
OF THE DESIGN/BUILD METHOD TO  
MILITARY CONSTRUCTION PROGRAM PROJECT:

THESIS

William W. Buckingham  
Captain, USAF

AFIT/GEM/LSM/89S-5

DEPARTMENT OF THE AIR FORCE  
AIR UNIVERSITY  
**AIR FORCE INSTITUTE OF TECHNOLOGY**

Wright-Patterson Air Force Base, Ohio

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AN INVESTIGATION OF THE APPLICATION OF THE DESIGN/BUILD  
METHOD TO MILITARY CONSTRUCTION PROGRAM PROJECTS

THESIS

Presented to the Faculty of the School of Systems and  
Logistics of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Engineering Management

William W. Buckingham, B.S.

Captain, USAF

September 1989

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## Preface

As funding for the Military Construction Program (MILCON) has decreased, it has become increasingly necessary to find quicker and more efficient methods to complete MILCON projects. One of the most promising methods to reach this goal is the design/build construction method.

This case study researches the design/build process currently being used in the civilian sector, and examines the application of the method to specific MILCON projects at Robins AFB and Scott AFB.

I would like to express my appreciation to my advisor, Major Hal Rumsey for the guidance and direction he provided. His encouragement and timely guidance made the completion of this thesis possible. I would like to thank my readers, Captain Jon Morrill and Captain Rick Wheeler, for their technical review and learned advice. I am thankful for the support I received from the DCS of Engineering and Services at HQ AFLC and HQ AFCC.

Last, but not least, I would like to express my deepest gratitude to my wife, Lynne, and our three sons, Bill, Brendan, and Baird, for their support and understanding during the long hours of work that have resulted in this thesis. They were my greatest source of strength.

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Abstract

In recent years, Air Force senior leadership has become increasingly concerned with the use of the conventional design-bid-construct acquisition process for Military Construction Program (MILCON) projects. The process is perceived by the users as being slow and unresponsive. In an effort to improve the MILCON process, the Air Force has been experimenting with the design/build acquisition method. This case study examines the design/build method used by three private sector contracting firms, and looks at the results of the application of the design/build method to two Air Force MILCON projects. The research objectives were to study the steps involved in the design/build methods used in the private sector and compare them to the method used by the Air Force and to determine if the method was effective in reducing the time and costs required for MILCON projects.

The results showed that the design/build method used by private sector firms has proven to be effective in reducing the time required to construct a facility. However, in some cases, the cost of a facility constructed using the design/build method will actually be higher than if it were built using the conventional design-bid-construct method.

The results also indicated that the design/build method used by the Air Force is very similar to the method used in the private sector. The method was successful in reducing the time required to complete the Robins AFB Dining Facility

at Robins AFB, Georgia and the AFCC Headquarters Facility at Scott AFB, Illinois. The cost for the Robins project was significantly less; however, the cost of the Scott project was similar to what it would have been if the conventional method had been used. In addition, the results showed that the use of the design/build method should be restricted to the construction of simple, straight-forward projects until government personnel become more familiar with the process.

AN INVESTIGATION OF THE APPLICATION OF  
THE DESIGN/BUILD METHOD  
TO MILITARY CONSTRUCTION PROGRAM PROJECTS

I. Introduction

Overview

This chapter provides a brief background on the facilities acquisition process and the design/build construction method. The specific problem, the research objectives, and the research methodology are presented. The scope and limitations of the study are also included in the chapter.

Background

The Military Construction Program (MILCON) is the primary method for obtaining new facilities and major renovations of existing facilities in the Department of Defense (DOD). The process begins when the need for a facility is recognized and programming documents are prepared by the requiring base. The programming documentation is submitted through the base's major command (MAJCOM) to Headquarters Air Force and finally to Congress for approval and authorization. As the programming process is completed, the design and construction process begins. The conventional design and construction process uses an architect-engineer firm to first design the project

and then a general contractor to construct the facility. The process takes approximately five years from the time the need for a facility is identified until construction is completed (8:8-30,17).

During the past few years, there has been growing concern in the Air Force that the conventional acquisition process for MILCON projects is inefficient and perceived as unresponsive by the users. In his December 1987 Air War College research report, Col Donald Thomas stated,

There are a variety of reasons the facility acquisition process must be reformed. The reduction of officers in the military and the impact of the Gramm-Rudmann Act will reduce the number of managers while increasing the need to manage. The rising cost of operational and direct support facilities will reduce the funds available to meet the higher expectations of the military population for better working and living conditions. (27:46)

A 1986 report, written by a committee headed by J. B. Cole, Deputy Regional Civil Engineer, Central Region, to Major General Clifton D. Wright, Director, Engineering and Services, Headquarters, United States Air Force, on design and construction strategies stated that "the MILCON process has many shortcomings which inhibit successful execution (7:8)". This report found the main problems with the facilities acquisition process to be

1. The project definition was generally poor.
2. The MILCON cycle was too long.
3. The budget estimates were inaccurate.
4. The process encouraged change orders (7:13).

To improve the MILCON process, the report made six recommendations:

1. Institute better design and construction practices.
2. Use a project delivery (business) strategy.
3. Consider design/build procedures.
4. Review the application of current small business rules.
5. Expand the use of Title II (architect-engineer (A-E) inspection) services.
6. Incorporate pre-qualifications in solicitations for contractors (7:22-29).

Of the six recommendations, one has already proven to be effective in reducing both the costs and the time required to complete a construction project in the private sector; the design/build construction method (23). In the design/build process, one contractor is responsible for both design and construction, thus expediting project completion. The motivations that have led to the use of the design/build method in the civilian sector tend to focus on time and cost savings and single source responsibility (30:61). The Military Construction Authority Act of 1986 authorized the three military branches to use the design/build process for facility acquisition (18:47). Since gaining approval to use design/build procedures, the Air Force has used the technique for a few select MILCON projects. In addition, a number of future MILCON projects are being programmed to be completed using the design/build method (13). A list of all

Air Force MILCON projects completed, or programmed to be completed, using the design/build method is shown in Table 1. The design/build process may have the potential to improve the responsiveness and efficiency of the MILCON process.

#### Problem Statement

With annual Air Force MILCON program costs exceeding \$1.5 billion and the average project taking approximately 5 years to complete, it is imperative that all possible methods of reducing costs and time be investigated (3). Many civilian construction contractors have successfully used design/build procedures for a number of years. These contractors have been able to provide high quality facilities in a fraction of the time required using the conventional design-bid-construct method, and many times at a much lower cost (30:61). How are they able to complete facilities in such short periods of time without sacrificing quality? And of greater importance, can the design/build procurement method improve the MILCON process by reducing costs and expediting project completion?

#### Research Objectives

The overall objective of this research was to determine if the design/build method improves the facilities acquisition process. To achieve this objective, sufficient data was gathered from interviews with civilian design/build construction firms and Air Force MAJCOM construction program

**TABLE 1. AIR FORCE DESIGN/BUILD  
MILCON PROJECTS**

FISCAL YR	PROJECT TITLE	BASE
1984	HEATING PLANT	K. I. SAWYER AFB, MI
1985	AFCC HQ FACILITY	SCOTT AFB, IL
1987	BASE DINING FACILITY	ROBINS AFB, GA
1987	MUNITIONS MAINTENANCE FAC	DYESS AFB, TX
1988	STUDENT HOUSING FACILITY	LACKLAND AFB, TX
1988	ADAL CRYPTO SUPPORT FAC	KELLY AFB, TX
1989	B1B SUPPORT FACILITY	TINKER AFB, OK
1989	STUDENT HOUSING FACILITY	SHEPPARD AFB, TX
1990	STUDENT DORMITORY DLI	LACKLAND AFB, TX
1990	DINING FACILITY DLI	LACKLAND AFB, TX
1990	POWER PLANT	VANDENBERG AFB, CA



managers to identify the steps in the design/build process used by the government and the civilian companies, and to determine if the method improved the facilities acquisition process. To achieve these goals, the following research sub-objectives guided the investigation:

1. Determine the steps involved in the design/build method used by civilian construction firms.

2. Determine the steps involved in the design/build method used by the Air Force.

3. Determine if MILCON projects completed using the design/build method are completed on schedule and at a lower cost than MILCON projects completed using the conventional method.

4. Determine if the project complexity has an impact on the use of design/build procedures.

#### Research Questions

To accomplish the research objectives, data was collected to answer the following research questions:

1. What are the steps used in the design/build process in the civilian sector?

2. What are the steps in the design/build process used in the Air Force?

3. How does the time required from the start of design to the completion of construction for design/build procedures compare to conventional procedures?

4. How does the contract cost of design/build projects compare to the cost of conventional projects?

5. Does the design/build process work equally well for complex as well as simple projects?

6. What type of projects are best suited for design/build construction?

7. Why is the design/build process used in the private sector?

### Scope and Limitations

The study initially focused on the design/build process and how it is applied by civilian construction contractors who specialize in the technique. Due to cost and time constraints, only three civilian design/build firms within a day's drive of Dayton, Ohio were included in the research.

Next, the research narrowed its perspective to studying in detail those Air Force MILCON projects that had been completed, or are under construction, using the design/build method. The study was limited to the design and construction phases of the facility acquisition process. Currently, only two large scale MILCON projects have been completed, or are nearing completion, using the design/build method; the Air Force Communications Command (AFCC) Headquarters Facility and the Robins AFB Dining Facility.

### Methodology

The most appropriate technique to resolve the research problem is a case study. To answer the questions of how the

civilian contractors are able to construct high quality facilities in short periods of time and whether or not the Air Force design/build MILCON projects were completed in less time and with similar quality to conventional construction methods involves the basic principles of a case study; developing a qualitative hypothesis through the detailed analysis of a limited number of conditions and their interrelationships (9:61).

### Data Collection

Data to be analyzed in this study were gathered primarily using the personal interview technique. The personal interview method provides information in much more depth and detail than other collection procedures. In addition, this method allows the interviewer to probe with additional questions when appropriate, to obtain more detailed information in areas of greater interest. Personal interviews also provide an opportunity to examine special materials made available by the respondent such as project schedules and records (9:160-162).

The personal interview technique has two primary disadvantages, cost and bias. Personal interview costs can run anywhere from a few dollars to hundreds of dollars for an interview with a hard-to-reach person (9:161).

Where personal interviews were not possible, telephone interviews were conducted. Telephone interviews are

advantageous primarily because they are inexpensive.

However, telephone interviews do have disadvantages. The length of an interview is usually limited when using the telephone. In addition, studies indicate that telephone interviews can result in less complete responses (9:170-171).

Bias can be inserted into an interviewee's response if an interviewer does not work to ensure that his probing is neutral and appears to be a natural part of the conversation (9:164). To reduce bias, the interviewees were allowed to discuss areas associated with the topic with minimal input from the interviewer. The interviews with the civilian design/build firms began with demographic questions such as size of the firm, type of facility construction they specialize in, and the amount of design/build construction completed in the past year. The interview then focused on the steps involved in their particular design/build process. Interviews with the MAJCOM construction program managers began with questions on their perceptions of design/build construction and the steps involved in the design/build process used to complete MILCON projects. Problems encountered using the process, and advantages of its use were also discussed. Interviews with both the civilian design/build firms and the MAJCOM construction program managers were limited to not more than one hour. If during the course of the interviews with the MAJCOM construction program managers it became apparent that other Air Force

personnel had knowledge that was useful to this research, an attempt was made to interview them also.

In addition to personal interviews with the MAJCOM construction program managers, data on the completed design/build MILCON projects was obtained from the Program, Design, and Construction (PDC) package on the Work Information Management System (WIMS), and the Army Corps of Engineers (COE) monthly construction status reports.

#### Population and Sample

Due to the exploratory nature of the research on the design/build process used by civilian firms, a non-probability sampling technique was used. In particular, a judgement sample was employed. A judgement sample is based on the researcher's judgement; it is not a random sample. Because a non-probability sampling technique was used, the generalization of the research results will be limited to the firms sampled. However, general concept applications should be useful for comparison to the Air Force design/build method.

Likewise, the research on the two design/build MILCON projects was strictly exploratory. Exploratory research is oriented toward obtaining information that is insightful, rather than obtaining a representative cross-section. Therefore this research attempted to gain insight on the success or failure of the design/build method to improve the MILCON process for two particular projects. Although the

research findings are not generalizable to all MILCON projects, they do provide valuable information on the effectiveness of the design/build process.

#### Developing Historical Background

A thorough literature review was conducted on existing articles written on the design/build method and case studies of the application of design/build techniques to military construction projects. The information gathered provided the catalyst to use a case study as the research methodology.

#### Development of the Personal Interview Questionnaires

The comprehensive personal interview questionnaires presented in Appendices A and B were prepared based upon information obtained in the literature review. The questions were designed to explore all facets of the design/build method used by private sector contractors, as well as the effectiveness of the design/build method in reducing the cost and the time required to complete MILCON projects.

#### Synthesis

All information obtained through the literature review, personal interviews, telephone interviews, and site visits was synthesized and presented in Chapters 3 and 4 of this thesis.

### Summary

The design/build method has been used in the private sector to improve the facility acquisition process. The technique has proven to be effective in reducing the time and cost required to construct a facility. In addition, the technique provides a single source of responsibility which ensures an efficient exchange of information between client and contractor. In an attempt to improve the MILCON process, the Air Force has been testing the design/build method to see if it is effective in reducing costs and the time required for project completion. This research studied the design/build method used in the private sector, and then analyzed in detail the Air Force design/build projects recently completed, or nearing completion, at Scott AFB, Illinois and Robins AFB, Georgia.

## II. Literature Review

### Overview

This chapter presents a review of the literature related to the facilities acquisition process and the design/build method. The review begins by presenting background on the Military Construction Program (MILCON) and the conventional construction contract, and then discusses project management, the design/build method, including the one-step turnkey method and the two-step turnkey method, and finally examines past uses of design/build methods by the military.

### The Military Construction Program

The MILCON process is the main method for obtaining new facilities and major renovation projects in the Air Force. Facilities acquisition consists of three phases: 1) Programming (requirement identification is part of this phase), 2) Design, and 3) Construction, as shown in Figure 1 (8:8).

The primary purpose of the programming phase, the first of three phases, is to perform the analysis needed to determine project feasibility as well as establish the major parameters of the project, including cost estimates, concept design, and identification of functional requirements. During this phase, a justification to proceed is documented and a decision to proceed to the next phase is made. This



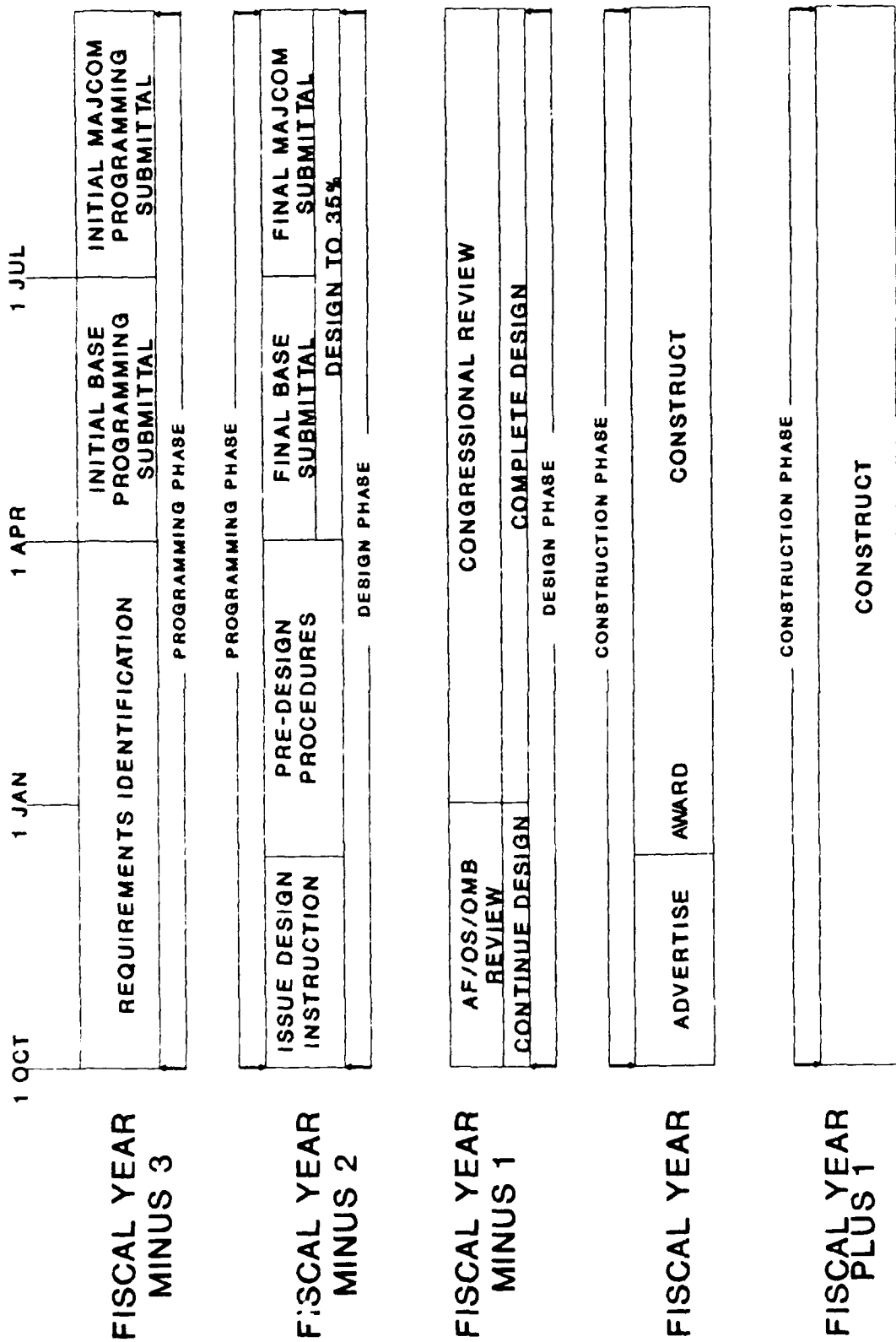


FIGURE 1. THE MILCON PROCESS

decision is based upon the criteria and procedures laid out by law. This phase overlaps the design phase, because some design is completed to support the decision making process, provide better estimates of funding needs, and refine project scopes (8:9).

The design phase covers the time spent in the preparation of the design drawings and specifications which will be used to construct the project. The overlap between the programming and design phases occurs because designs can be both preliminary sketches or a more complete set of drawings. Preliminary design and estimates must be prepared in the programming phase. These preliminary designs provide the firm designing the project with a rough idea of what the government is looking for, and establish the scope for the final project designs and specifications created during the second phase. During this phase of the project, design is often revised because user requirements have changed or because of changed design standards or scope (8:9).

The third and final phase, the construction phase, consists of solicitation of bids from private sector contractors, management of the construction of the project, final inspection, and project acceptance (8:10).

This procedure requires awarding two contracts; one a negotiated contract to obtain an architect-engineering (A-E) firm to design the project, and a second competitively bid contract to obtain the contractor to actually construct the facility.

Colonel Donald Thomas stated

From the time the user requests the facility to the time the facility is turned over to the user, usually takes from four to five years -- a long time with the proponents changing several times during the process.  
(27:21)

### Project Management

The project management approach is relatively modern. It is characterized by new methods of restructuring management and adapting special management techniques, with the intent of gaining better control and use of existing resources. The technique has been used for years by DOD contractors and construction firms, but now is being applied in such diverse industries as defense, construction, pharmaceuticals, chemicals, banking, hospitals, advertising, law, state and local governments, and the United Nations  
(16:1-2).

Traditional organizational structures are highly bureaucratic, and experience has shown that they do not respond well to changing environments. Project management, however, is highly organic and can respond very rapidly as situations develop inside and outside an organization  
(16:2).

According to Clifford F. Gray,

A project is a complex of nonroutine activities that must be completed with a set amount of resources and within a set time interval. Project management is planning, scheduling, and controlling the complex of nonroutine activities that must be completed to reach the predetermined objective or objectives of the project. (12:1)

Dr Harold Kerzner defined project management in the following manner,

Project management involves project planning and project monitoring and includes such items as:

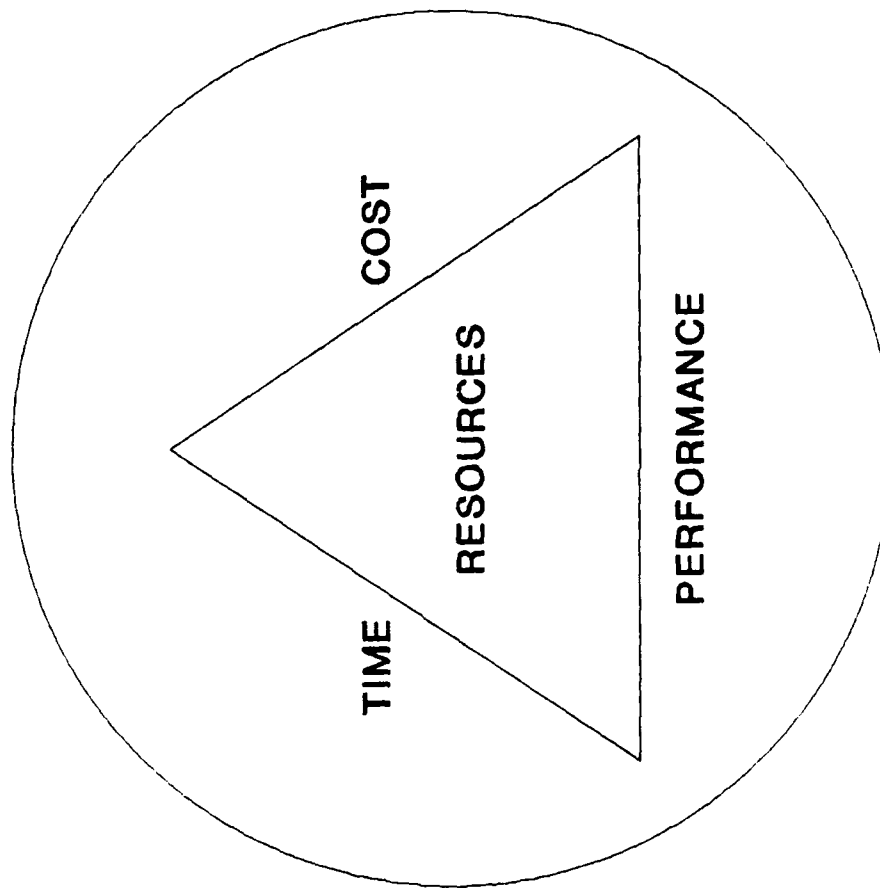
- Project Planning
  - Definition of work requirements
  - Definition of quantity of work
  - Definition of resources needed
- Project Monitoring
  - Tracking progress
  - Comparing actual to predicted
  - Analyzing impact
  - Making adjustments (16:2-3)

Figure 2 is a graphic representation of project management. The figure shows that project management is designed to manage or control organizational resources on a given job, within time, within cost, and within performance constraints, while maintaining good customer relations (16:5-6).

When applying project management methods, experience has shown that the project manager and his team, and the customer's organization, can take certain actions to help stimulate project success. Actions that the project manager and team can take include:

1. Select key team members with proven track records in their fields.
2. Develop commitment and a sense of mission from the outset.
3. Coordinate and maintain a good relationship with the client and the team.
4. Have key team members assist in decision making and problem solving.
5. Develop realistic cost, schedule, and performance estimates and goals.

**GOOD CUSTOMER RELATIONS**



**FIGURE 2. OVERVIEW OF PROJECT MANAGEMENT**

6. Have back-up strategies in anticipation of potential problems.
7. Employ a workable set of project planning and control tools.
8. Stress the importance of meeting cost, schedule, and performance goals.
9. Give priority to achieving the mission or function of the end item.
10. Keep changes under control (16:443-444).

Actions the customer can take to help ensure project success include:

1. Show a willingness to coordinate efforts.
2. Maintain rapport with the project manager and his team.
3. Establish reasonable and specific goals and criteria.
4. Ensure a well-established procedure for changes is in place.
5. Provide prompt and accurate communications.
6. Minimize the "red tape".
7. Provide the client contact with sufficient authority, especially for decision making (16:445).

#### The Design/Build Method

In an article on design/build contracts in the February 1988 issue of Building Design and Construction, Milton F. Lunch stated,

The use of design/build procedures has generated considerable attention in recent years. The process has been used for many years. What is different now, however is its increasing use on public projects, whereas in the past it was largely utilized for private sector industrial-type projects (18:47).

The design/build construction procedure has two different forms:

1. The One-step Turnkey Method.
2. The Two-step Turnkey Method.

In addition, a technique called the systems approach is often combined with the design/build method to expedite the construction process.

One-Step Turnkey Method. The one-step turnkey procedure, long advocated by the U.S. Navy, has been used by all three service branches in the procurement of military family housing since the early 1970's (25:56). However, it had not been used for MILCON construction until December 1985, when Congress authorized each branch of the military to use one-step turnkey procedures for up to three MILCON projects per year until 1 October 1990 (19:A-12).

In his 1974 thesis on turnkey construction, Lt Commander John Ster found that,

Under the Navy one-step turnkey procedure, a request for proposals (RFP) is publically advertised. The RFP sets forth the scope of work, information concerning site boundaries, topography, utility services, soil and subsoil conditions, and a complete description of the terms of the proposed contract with ground rules for submission, evaluation and selection of a proposal. The methods of evaluation and selection are then applied and award made. Selection and award are predicated on the maximum quality for a fixed price. Thus, the most innovative application of design, construction methods, and materials is achieved within identified project funds. (25:108)

In 1972, Mr B. J. Skillito, Assistant Secretary of Defense, Installations and Logistics issued guidance to the three services which stated that projects suitable for one-

step turnkey procedures included the following:

1. Family housing units.
2. Temporary lodging facilities.
3. Bowling Alleys.
4. Swimming pools.
5. Small training and administration buildings (25).

In 1985, Major General Clifton D. Wright, Director, Engineering and Services, Headquarters, United States Air Force directed the formation of a group to study methods to improve the MILCON process. One of the methods proposed by this group was a one-step design/build procedure. This procedure, although similar to the Navy's one-step process, does have some slight differences. The Air Force procedure begins with a project definition phase which is used to develop the conceptual aspects of the project. The documentation developed in this phase, minus government cost estimates, is used as the specification package for the design/build solicitation, called a Request for Technical Proposal (RFTP). The solicitation schedule consists primarily of two line items: one for A-E design and one for construction. The bid portion for the design is firm, while the construction bid price is the contractor's best estimate based on available information provided in the RFTP. Selection of the successful proposal is based on several factors including quality, cost and technical capability (7:22-24).



Evaluation of the technical proposal can be accomplished in several ways. Options include:

1. Formal source selection procedures.
2. A two-step procedure using unweighted technical elements.
3. A weighted technical/cost procedure (7:24-25).

As an example, a method employed by the Army Corps of Engineers using technical elements and cost assigns a maximum rating under the evaluation system of 1,000 quality points. Technical evaluation areas, in decreasing level of importance, can be as follow:

- |   |     |
|---|-----|
| 1. Quality of proposed design and construction        | 40% |
| 2. Construction management plan                       | 15% |
| 3. Building design parameters                         | 15% |
| 4. Site engineering parameters                        | 10% |
| 5. Site design parameters                             | 10% |
| 6. Energy conscious design and engineering parameters | 10% |

After the quality ratings of proposals have been determined, their relative value in terms of proposed price will be established by means of a price/quality point ratio:

$$\frac{\$ \text{ Price}}{\text{Quality Point Rating}} = \$ \text{ Per Quality Point}$$

The dollar per quality point ratio would be considered one of the major factors in comparing technical quality with proposed prices. Contract award will be made considering the specific requirements established in the RFTP on the basis of price, technical, and management factors (7:25).

During the design phase of the contract, the successful bidder would be required to furnish a Guaranteed Maximum Price (GMP) for the construction portion of the agreement. Depending on the size and complexity of the project, the GMP phase point ranges from 15 to 40 percent of project design. This phase point is specified in the RFTP. At the GMP phase point, the Air Force can exercise various options. The GMP can be accepted as fair and reasonable and the contractor can be locked in contractually for the construction of the project. Conversely, if the contractor's GMP is excessive, either over or under his bid price, the Air Force can either continue with and complete the design portion and then compete the construction portion on the open market, or simply pay the contractor for design efforts to that point and then complete the design effort in-house or with another A-E firm (7:25-26).

Two-Step Turnkey Method. The two-step formally advertised method also utilizes a publically advertised RFTP; however, the initial proposals are submitted without a sealed fixed price. After the proposals are technically evaluated and identified as to acceptability or non-acceptability, sealed bids are then submitted by the proposers of acceptable proposals. Selection and contract award are based on the lowest responsive bid as bounded by identified project funds (25:108, 21:12).

Assistant Secretary of Defense Shillito's guidance stated that projects suitable for procurement using two-step

turnkey procedures include:

1. Packaged type power plants.
2. Packaged sewage treatment plants.
3. Incinerators.
4. Standard commercial, small, general-purpose hangars and other aircraft shelters.
5. Standard commercial, small warehouses.
6. Equipment and/or process systems installation.
7. Electrical switchgear and substations.
8. Boiler conversions.
9. Automated material handling systems (25).

Systems Approach. Stated simply, "A systems approach to MCA [MILCON] allows the acquisition of available building systems as an option to conventional construction (20:9)."

In comparing the systems approach to the conventional facility acquisition process, Thomas R. Napier and L.

Michael Golish stated in A Systems Approach to Military Construction:

In a traditional design and construction process, the Architect Engineer (AE) develops a design program based on the client's needs, then designs and details a design program based on the client's needs, then designs and details a solution to those requirements. Contractors bid competitively and the contractor placing the lowest bid on the AE's prescribed solution is awarded the contract. In a systems approach, the AE expresses the clients' requirements via functional criteria and solicits proposals in response to a Request for Technical Proposal (RFTP). Contractors develop their own solutions to the specified design and construction requirements, and the client and AE select the most favorable proposal for award and construction, be it conventional, industrialized, or any variation thereof. (20:9)

With the systems approach to construction, a facility can be built using a complete building system, by combining manufactured subsystems into a complete building, or by combining selected manufactured subsystems with conventional construction. Complete building systems are available through licensed or franchised contractors and occasionally through general contractors. Manufactured subsystems are available through franchised contractors or through general contractors. Subsystems are sometimes marketed through outlets and distributors. Since subsystems are usually manufactured independently, each system must be coordinated into the complete building design (20:19-21).

The main advantage of the systems approach is that it can solicit many suitable options for project completion and maximize competition among them. The Air Force can then identify the most favorable solution at the lowest price (20:9).

The disadvantages of the systems approach are 1) The scope of projects that can be constructed using the technique is limited, and 2) Appropriate systems building products are not available in some locations (20:19).

Advantages of Design/Build Methods. Lt Commander Star found the advantages of the design/build over the conventional construction process include the following:

1. Earlier project completion when design and construction proceed concurrently.
2. Excellent information interchange, design and construction transfer, and a single point of contact.

3. Maximum design competition and reduced DOD design costs.
4. Contract award based on optimum quality for the price (one-step turnkey method).

In addition, the contractor is responsible for change orders resulting from design errors. This reduces the risk of cost growth to the government which results from errors in conventional methods (7:29).

Design/build projects are also well suited to "fast tracking" because the schedule can be controlled by a single entity. "Fast tracking" is the technique of expediting all phases of a project so a very short deadline can be met. The close interaction between design and construction operations also assures a better product (6:52-53).

Disadvantages of Design/Build Methods. The main disadvantages with design/build construction procedures are:

1. The client must be willing to pay for the up-front preparation of an RFTP that will ensure minimum cost risk to the design/build firms that compete (7:29).
2. The client loses some degree of design control (7:29).
3. No credit can be given for higher quality designs; any proposal meeting the specifications wins if it is the low bid (two-step turnkey method) (21:61).

In addition, Mr John Gallagher found that contractors do not like to prepare competitive bids on turnkey projects when their workload is heavy. This is due to the high cost of preparing a bid package for a turnkey project. Gallagher

found that during periods of slow economic growth, bidding turnkey projects by design and construction firms was heavy (11:218).

#### Past Use of Design/Build Methods

Although design/build methods are thought to be fairly new, the military has had some limited experience using the process since the 1960's.

Project Turnkey - 1966. In 1966, during the Vietnam Conflict, the Air Force found that it could not meet all the combat flying requirements from the three bases they had in Vietnam. To correct the situation, the Air Force decided to construct a fourth jet base at Tuy Hoa, a sandy delta on the South China Sea 240 miles northeast of Saigon. The base had to be able to provide interim air operations by not later than the end of December 1966 and sustained air operations by mid-1967. The civilian construction combine, called RMK-BRJ (Raymond International Inc., New York; Morrison-Knudsen Co. Inc., Boise, Idaho; Brown-Root Inc., Houston; and J.A. Jones, Charlotte, North Carolina), which had accomplished all construction in Southeast Asia (SEA) since 1962, had over \$500 million in on-going construction projects and could not meet the required completion date for Tuy Hoa (29:2-4).

To meet the stringent time constraints, the Air Force proposed a one-step turnkey construction method which would be performed by an American contractor not previously

involved in SEA. In March 1966 the Air Force began negotiating with civilian construction contractors. Nine construction firms were solicited to provide estimates on the Tuy Hoa project, which became known as Project Turnkey, and the contract was awarded to Walter Kidde Construction (WKC) of New York on 27 May 1966 (29:7-8).

Since only seven months remained before the interim airfield was required, the project schedule required WKC to:

1. Complete all designs by 31 August 1966.
2. Complete mobilization of forces, material and equipment, and be ready to start work by 30 September 1966.
3. Complete construction of interim air field facilities by 27 December 1966.
4. Complete all remaining airfield construction by 24 June 1967 (29:8-9).

Within three weeks of contract award, WKC had the first ship leaving Philadelphia with a portion of the 3.4 million square yards of AM-2 matting needed for the interim airfield. Within seven and a half months the last ship was bound for Tuy Hoa. When completed, over 161,000 tons of material were delivered to Tuy Hoa (29:11-12).

Designs for the project were kept as simple as possible, and ease and rapidness of construction were emphasized. Maximum use was made of off-the-shelf products. WKC completed the design within the original 90-day contract stipulation (29:13).

The first workers arrived at Tuy Hoa in early June 1966 and the first ship of materials arrived on 11 August 1966.

Construction on the interim runway commenced on 25 August 1966. On 12 November 1966, the last piece of matting was locked into place, completing the interim airfield a full six weeks ahead of schedule. By 23 April 1967, the concrete airfield was completed and on 10 June 1967 the last of the facilities was completed, a full two weeks ahead of schedule (29:14-15).

Project Turnkey demonstrated the effectiveness of a one-step turnkey contract in completing construction where time is a premium. Because the contractor constructing the project had also designed it, decisions on construction changes were made on site, thus avoiding delays and ensuring work was completed on schedule. Total cost of the project was \$52 million (29:16).

The TACOM Facilities, Warren, Michigan - 1980. In October 1979, Volkswagen of America (VWA) was instructed by its parent corporation in the Federal Republic of Germany to find an existing facility in the United States that could be converted to auto production by the summer of 1982 (5:8). VWA assigned a team to search for and select a site appropriate for the facility. One of the members had formerly been employed at the Army's Michigan Army Missile Plant (MAMP) in Sterling Heights, Michigan and proposed the plant as a potential site for auto production. VWA contacted the Development and Readiness Command (DARCOM) Real Estate Division and proposed a real estate exchange,



rather than pursuing General Services Administration's (GSA's) property disposal process, which takes up to 4 years (5:8-9).

The MAMP site could not be turned over to VWA until the Army Automotive Tank Command (TACOM) could be relocated. To make the conversion possible, the state of Michigan offered to build two 196,000 square foot buildings in Warren, Michigan for TACOM in exchange for the MAMP site. The Army agreed to the exchange, and Congress enacted special legislation to approve it. The main goal of this project was to evacuate TACOM to the new quarters in Warren in time for VWA to convert the MAMP site to meet its 1982 deadline. In addition, VWA did not want to pay more than the fair market value for the MAMP facility. Thus, the state of Michigan agreed to build the TACOM facilities at a cost of less than \$20 million (5:5-9).

Given the severe time constraints, the building delivery team, composed of representatives from the Corps of Engineers, the state of Michigan, and VWA, decided to use a design/build approach for acquisition of the facility. In addition, to speed construction, the team also decided to use the systems approach to construction whenever possible. The state of Michigan used a one-step turnkey contracting technique and received four proposals, which had been developed to about 20 percent of design completion. All proposals were considered acceptable and the low

bidder- Andreas, Stroan, and Reinhart of Troy, Michigan -was awarded the contract (5:8-9).

The day after the exchange agreement was signed, structural steel was delivered to the construction site. Construction began immediately and site work was completed before the final design was finished. The Army took beneficial occupancy of the first building just 16 months after the contract had been awarded. Three months later, the second building was beneficially occupied. Corps of Engineers estimates for conventional design of these buildings was one year, with construction taking an additional three and a half years (5:10).

Total cost for the TACOM facilities was \$19 million with construction change orders and contractor claims accounting for less than one percent of the total amount. Everyone involved with the project indicated that the quality of the completed buildings was excellent (5:10).

The Army's Two-Step Turnkey Projects - 1982. In 1980, the Army selected three projects from the FY 82 MILCON to test the effectiveness of the two-step turnkey contracting method. The projects included a headquarters and classroom building at Fort Drum, New York; a physical fitness center at Fort Benjamin Harrison, Indiana; and a fire station at Fort Stewart, Georgia (21:9).

For two of the three pilot projects, the classroom building and the fitness center, pre-engineered building systems proved to be most cost effective. Conventional

construction was most economical for the fire station, approximately \$365,000 less than a pre-engineered metal building system. Costs for all three buildings were 28 to 32 percent below the estimated costs for a similar facility constructed using the conventional design-bid-construct method (21:54-61).

The Fort Drum classroom building and the Fort Harrison physical fitness center were completed in 50 to 75 percent of the time required to complete similar projects using the conventional method. The Fort Stewart fire station, however, took approximately 180 days longer than the time specified in the RFTP. The delay was the result of the mechanical subcontractor's default and bad weather, and was not caused by the two-step turnkey contracting method (21:48-49). The quality for all three facilities was judged to be as good as expected for conventional MILCON projects (21:61).

The main drawback noted for the two-step procurement method for these projects was that firms proposing higher quality designs than the minimum acceptance standard could not be awarded the contract, even though their bid was within the government-estimated range (21:61).

The Army's One-Step Turnkey Test Projects - 1984. In October 1983, the Army Corps of Engineers, authorized by HR 98-238 to test the one-step turnkey contracting method, selected two projects from the FY 84 MILCON as one-step turnkey test projects. The projects selected were: a

physical fitness center at Fort Bliss, Texas; and a physical fitness center at Fort Stewart, Georgia (22:13).

Total construction cost for both facilities was below that estimated for the conventional approach, 16 and 28 percent less respectively. The contractor who was awarded the contract for the Fort Bliss fitness center was ranked second in quality points and had the second lowest bid. The contractor who was awarded the contract for the Fort Stewart fitness center was ranked third, out of three, in quality points, but was the low bidder. Quality for both projects was judged to be at least as good as that normally expected in MILCON projects of this type (22:23).

The Fort Bliss project was completed on schedule; however, completion of the Fort Stewart project was delayed by 127 days. The Fort Stewart project was delayed due to a disagreement between the contractor and the Corps of Engineers over the suitability of the contractor's proposed swimming pool design. Both projects required less time than had been estimated if they had been procured using the conventional approach (22:34-35).

The one-step turnkey method was judged to have worked well for both projects. In addition, the Fort Bliss project demonstrated the advantage of being able to award the contract to the proposal that represents the best balance between quality and cost (22:19).

Table 2 presents a summary of all military construction projects completed using design/build techniques through

1984. The table compares the time required, the cost, and the quality of construction for the military design/build projects to similar requirements for the conventional design-bid-construct method.

**TABLE 2. A COMPARISON OF MILITARY  
DESIGN/BUILD PROJECTS**

PROJECT	DESIGN/BUILD METHOD	PROJECT COMPARED TO CONVENTIONAL METHOD			YEAR OF PROJECT COMPLETION
		TIME REQUIRED	COST	QUALITY	
TUY HOA AIR BASE	ONE-STEP TURNKEY	80 PERCENT LESS	SIMILAR	SIMILAR	1967
TACOM FACILITIES	ONE-STEP TURNKEY	60 PERCENT LESS	SIMILAR	HIGHER	1980
FORT DRUM HEADQUARTERS	TWO-STEP TURNKEY	50 PERCENT LESS	28 PERCENT LESS	SIMILAR	1982
FORT HARRISON GYM	TWO-STEP TURNKEY	25 PERCENT LESS	27 PERCENT LESS	SIMILAR	1982
FORT STEWART FIRE HOUSE	TWO-STEP TURNKEY	SIMILAR	32 PERCENT LESS	SIMILAR	1982
FORT BLISS GYM	ONE-STEP TURNKEY	35 PERCENT LESS	28 PERCENT LESS	HIGHER	1984
FORT STEWART GYM	ONE-STEP TURNKEY	SIMILAR	18 PERCENT LESS	HIGHER	1984

### III. Research Findings

#### Overview

This chapter presents the research findings that resulted from the personal interviews, telephone interviews, and site visits conducted on the design/build construction process. The findings represent data collected from the Miller-Valentine Group, Dayton, Ohio; Huber, Hunt and Nichols, Inc., Indianapolis, Indiana; and the Austin Company, Cleveland, Ohio; as well as data gathered on the new AFCC Headquarters Facility, Scott AFB, Illinois; and the new Robins AFB Dining Facility, Robins AFB, Georgia. The findings outline the design/build processes used by the civilian firms and provide a relative indication of the success of the design/build process in improving the facility acquisition process for MILCON projects.

#### Miller-Valentine Group, Dayton, Ohio

The Miller-Valentine Group is a multi-faceted organization which functions as a realty company and a development firm, as well as a design/build construction contractor. The company does most of its work in the Dayton-Cincinnati area, but they have also done projects in Atlanta, Georgia and Tampa, Florida. In 1988, the firm completed 18 design/build projects worth approximately \$ 45 million. Miller-Valentine first entered the design/build field 18 years ago. To date, most of the projects

they have constructed have been commercial: office buildings, light manufacturing facilities, distribution centers, hotels, and retail facilities. Miller-Valentine specializes in tilt-up construction, a process in which concrete walls are pre-formed and then "tilted-up" into place (14).

Miller-Valentine uses design/build salesmen to identify prospective projects. The salesmen qualify a prospective project to ensure that it is within the scope of the company's capability, that the client's needs are real, and that the client can afford the project costs. Once it is determined that Miller-Valentine is capable of constructing the project and the client's needs are firmed up, a project manager is assigned. The project manager becomes the client's single point-of-contact, in essence the only person the client has to deal with from the identification of his needs to the completion of construction (14).

The project manager begins by helping the client define his real needs and then determines how to best meet these requirements. Quite often an experienced project manager can show a client that he needs less square footage than he had originally thought. Regardless of the client's knowledge of his requirements, the project manager's goal is the same: to provide the user with a facility that will fulfill all of his needs. In the words of Terry Hanauer, a partner in the Miller-Valentine Group, the project manager's motto is "what ever it takes" (14).



Next, a preliminary design is developed. If the project is straight forward, the design will be developed in-house. However, if the requirement is more complex, Miller-Valentine will give the client an estimate of the cost to have an outside consultant do the work. When the preliminary design is complete, a design/build proposal is submitted to the client. The proposal includes:

1. A proposal letter.
2. Outline specifications (vary in detail according to client's desires).
3. Contract documents (American Institute of Architects standard documents).
4. Preliminary plans. These plans are pictorial in nature, showing the client what he will get without structural details and with gross dimensions.
5. Detailed schedule (not all projects) (14).

If the client accepts the proposal, the project manager then begins final design. Miller-Valentine does the structural design in-house, but if the project has complex mechanical or electrical requirements the project manager selects an A-E firm to do the designs for these portions of the project. If the mechanical and electrical requirements are not complex, Miller-Valentine will request proposals from mechanical and electrical contractors who specialize in design/build construction. Currently, more and more portions of the design are being subcontracted to specialty companies (14).

In addition to a project manager, Miller-Valentine also assigns a project coordinator and a field superintendent to

each job. The project coordinator is usually a young engineer who is new to the construction business. His job is to assist the project manager in managing the overall project. The field superintendent is the individual who supervises the actual construction of a facility. Miller-Valentine also uses their own construction crews to construct the structural portion of a project, but they hire experts to perform quality checks on the concrete, soil compaction, structural steel welds, reinforcing steel, and the roof (14).

When the project nears completion, the project manager functions as the client's point-of-contact for resolution of punchlist items identified as deficient during final inspection. In addition, the project manager serves as the client's liaison with the Miller-Valentine marketing branch, which handles the grand opening of the new facility and news releases associated with the opening (14).

The Miller-Valentine Group has found that the design/build method has worked best for clients who are not knowledgeable in construction practices. Most of their clients have been small business owners who are not experienced in buying construction, in many cases the purchase of a facility is the largest investment they will ever make. According to Hanauer, large companies such as General Motors and General Electric who have knowledgeable construction engineers in their employ, and are better equipped to define their requirements in greater detail,

have not shown a great interest in the design/build method. These companies are more likely to write clear specific specifications and look for the lowest responsible bidder to construct a facility (14).

According to Hanauer, the main advantages of the design/build method are time savings, improved flow of information, and more value obtained for the dollars spent. As an example of the potential savings in the time required to complete a project, First National Bank had a small facility built using the conventional design-bid-construct method which took eight months to complete. Miller-Valentine built a similar facility for First National using the design/build method and completed the project in just four months. In addition, the quality of the design/build facility was judged to be better than that of the conventionally constructed facility. The cost of the design/build facility was higher than the conventionally constructed facility, but the time saved far outweighed the additional expense. With the project manager serving as the client's single point-of-contact, as well as overseeing the total project, the chances of the client's needs and desires actually being fulfilled are greatly enhanced. The project manager's close contact with the client helps him to better understand the client's needs and ensures that those needs will be adequately met with the completed facility. Finally, Hanauer stated that with a good design/build firm, the chances that the design quality will more than exceed

the client's requirements is great, because the individual controlling the process is the one who will be constructing the facility. Because he is involved in both the design and construction of the facility, he is less likely to cut corners on the materials used in construction than a builder who is simply constructing a facility that has been designed by another firm. In other words, the builder's sense of ownership in a project is much greater with the design/build method (14).

Hanauer felt the biggest disadvantage of the design/build process is the client's lack of control over a project. The client is essentially putting his trust in the design/build firm to provide him with a facility that will meet his needs with minimum guidance. The client basically provides the design/builder with a performance specification and gives him free rein to come up with a method to meet his requirements. Some design/build companies could use this control as a "license to steal", therefore, it is essential that a client thoroughly investigate the past performance of a design/build firm before awarding a contract (14).

Huber, Hunt and Nichols, Inc., Indianapolis, Indiana

Huber, Hunt and Nichols is the largest single-office construction management and general contracting firm in the Midwestern United States. They currently have \$1.3 billion worth of projects under contract and they have about \$600 million of new contracts each year. The bulk of their work

is construction management; they have managed the construction of such notable facilities as the Hoosier Dome in Indianapolis and the Thanksgiving Building in Dallas. Currently, about 10 to 15 percent of their work is design/build; approximately \$70 million per year. Huber, Hunt and Nichols has been using the design/build method for about 20 years and they specialize in warehouse and distribution facilities (24).

When a prospective client comes to Huber, Hunt and Nichols, they sit down with them and discuss the client's needs. If it appears that the design/build process is the best contracting method to meet these needs, a project manager is assigned to manage the process and serve as the client's single point-of-contact. Huber, Hunt and Nichols does not have an in-house design capability, so the project manager's first task is to hire an A-E firm to design the project. A-E selection will be made from firms who have experience designing a particular type of facility. The selection is made on a competitive basis. The project manager reviews the design, with the client, throughout the design process to ensure that it meets the client's requirements (24).

Once the design is underway, the project manager develops a Critical Path Method (CPM) schedule for the client. This schedule is used to show the client which activities are time critical and is also used at every client-project manager meeting to update the client on the

progress of the project. The CPM schedule is vital to keeping the client informed of the progress of the project (24).

Huber, Hunt and Nichols has a large construction work force and they perform all of the structural work on a project. All electrical and mechanical work is subcontracted (24).

To make the design/build process work, Warner Peck, Chief of Construction Management for Huber, Hunt and Nichols said that it is imperative that good rapport be established between the client and the project manager. Good rapport is necessary to ensure that the client's needs are identified and met by the facility being designed and constructed. In addition, it is essential that the project representative from a client's organization be someone who is knowledgeable in company operations and needs, and has the authority to make decisions on the project. If the client's representative does not have these qualifications, the improved communications flow provided by the design/build process will in essence be wasted. It is also essential that the client assign a representative for the duration of a project to ensure continuity. If a client continually changes his representative, chances are that perceived project needs will also change continually causing delays in project completion while the contractor attempts to keep up with the changing requirements (24).

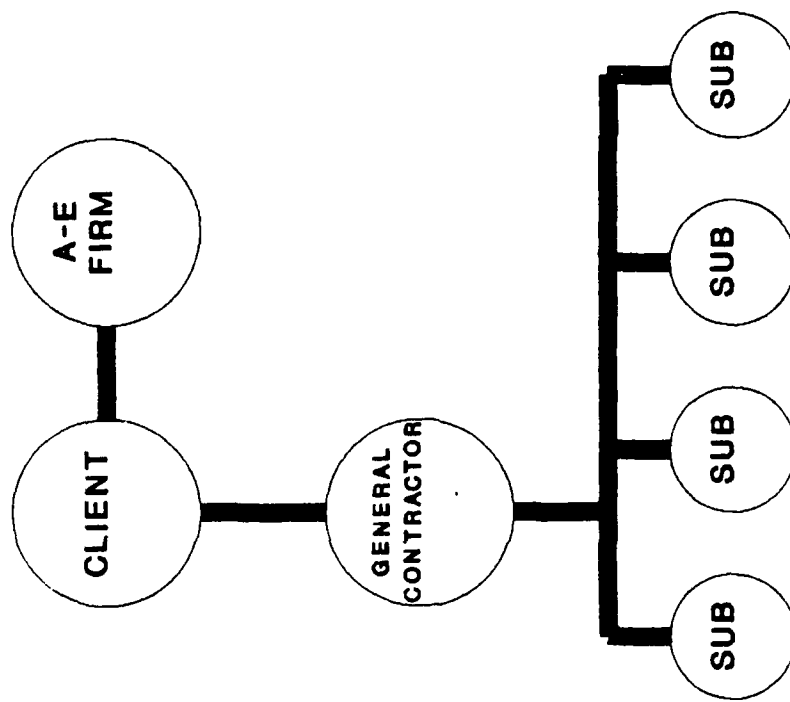
Peck said that the biggest advantages of the design/build process were time and cost savings, and that the process was the least burdensome on the client. Design/build allows a client to use phased construction, coordinate the design and construction, and simplify lines of communication; he only has to deal with the project manager. Figure 3 presents the client/contractor/A-E relationships for the design/build and conventional design-bid-construct methods (24).

According to Peck, the chief disadvantage of the design/build method is that the client places full responsibility on one firm: the design/build company. There are no checks and balances, as in design-bid-construct jobs. Quite often the client is forced to accept a "standard" solution. In many cases, the emphasis is on low cost rather than aesthetics, function, or maintenance (24).

#### The Austin Company, Cleveland, Ohio

The Austin Company is a large international A-E firm with headquarters in Cleveland and over 2,000 employees in offices located in major cities throughout the world. They have approximately \$600-800 million worth of projects under contract of which 60 to 70 percent are design/build. The Austin Company was formed 107 years ago, and they are the founder of the design/build method. According to Ronald Fatari, Facilities Department, Austin Company, the firm tries to act as a construction "supermarket". The firm has

CONVENTIONAL METHOD



DESIGN/BUILD METHOD

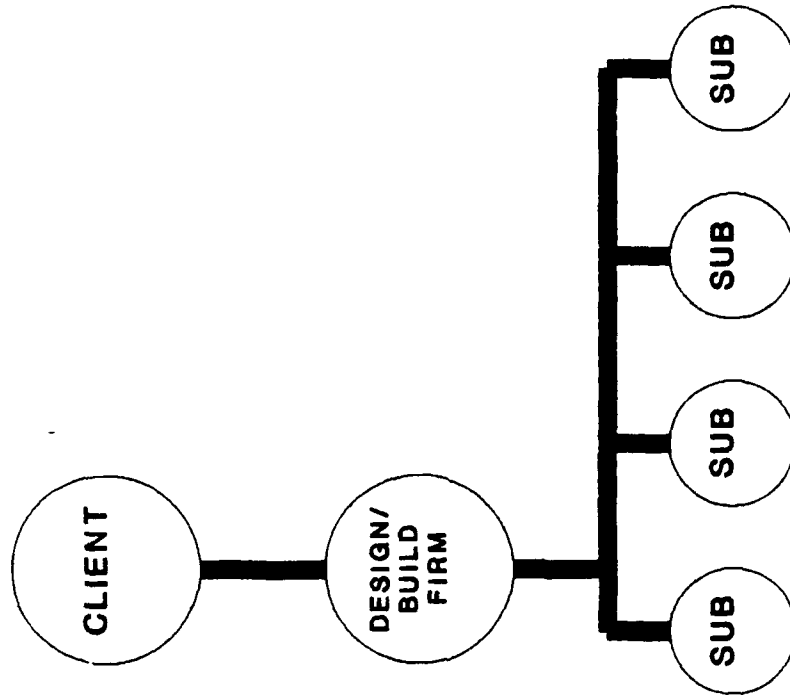


FIGURE 3. DESIGN/BUILD VERSUS CONVENTIONAL METHOD



a rich manufacturing heritage and is still very active in the construction of complex manufacturing facilities. They have constructed a wide variety of facilities using the design/build method including the following:

1. Newspaper facilities.
2. Electronic Data Processing (EDP) and computer centers.
3. Bank operations centers.
4. Broadcasting facilities.
5. Food processing facilities.
6. Research and development facilities.
7. Broadcasting facilities.
8. Office buildings.
9. Material handling/distribution/warehousing facilities.
10. Large span aircraft hangars and repair facilities (10).

Austin has a staff of salesmen who are responsible for finding projects for the company to bid. When they identify a project, the salesmen write a proposal for the prospective client and serve as the primary contracting officer for the job. If the prospective client shows an interest in the Austin proposal, a "kick-off" meeting, between the client and the design/build team, is arranged to determine what the client is looking for in a facility and how he wants to go about obtaining it. Austin likes to talk with at least two levels of management, the executive and mid levels, to ensure that they have a complete understanding of the

client's needs and desires. Based on the results of this meeting, a three-man team from the A-E department begins the preliminary project design by developing a space requirements proposal which represents Austin's best estimate of the size of the facility required to meet the client's needs. The design team next develops rough schematic diagrams, in block diagram form, to show the client alternatives to the facility layout. They also prepare a "ballpark" cost estimate for each alternative and begin to perform some architectural studies.. Throughout this preliminary design process, Austin holds milestone meetings with the client to keep them apprised of the project progress and obtain their input on what is and isn't satisfactory with the design (10).

If the client is still interested in the Austin proposal at this point, the design team develops the first bona fide to scale floor plan. In addition, whole site development drawings are completed, followed by specifications. These specifications do not include a construction specification; they are just complete enough to enable Austin's estimating department to make a good cost estimate. If the client accepts this first estimate, the estimating department then makes a detailed cost estimate. This detailed estimate usually takes from one to four weeks to complete and is guaranteed to be accurate to plus or minus ten percent. The estimate lists 16 to 20 line items that must be accomplished to complete the project, to inform

the client where his money will be spent. Based on this estimate, the client makes a decision of whether to continue with the project or not. If he elects to continue with the project, the contract is let based on the detailed estimate (10).

With contract award, the work goes to the engineering department where a crew of ten or more complete work on the final designs. The crew develops detailed working drawings, while ensuring that the design stays within the project scope. Most of the work done by Austin is done on a Guaranteed Maximum basis with savings shared by the client and Austin. The drawings are prepared to be universal for all bid packages to ensure maximum competition between subcontractors (10).

The purchasing department puts the bid packages together and determines what subcontractors will be given an opportunity to bid on the project. The list of potential subcontractors and vendors is reviewed with the client, and any additions or deletions he desires are made. When the subcontractor bids are received, purchasing evaluates them and makes a recommendation to the client as to which bid is best. However, the client can override purchasing's recommendation and choose another subcontractor (10).

With the completion of the detailed engineering drawings, Austin assigns a project manager to serve as the client's point-of-contact. The project manager's main task is to ensure that the client's needs are being adequately

covered; he is the individual whom the client will deal with after the preliminary designs are completed. The project manager generates a monthly status report to keep the client informed of the project's progress. This report includes a financial recap, an updated Critical Path Method (CPM) construction schedule, and a purchasing schedule which tracks bid packages, when drawings are submitted, and lists the successful bidders. The project manager is responsible for project close-out; ensuring all client concerns are addressed and resolved. In addition, he briefs the owner on the maintenance needs of the facility mechanical systems and provides the owner with the facility maintenance manuals (10).

When the actual construction of a facility begins, Austin assigns a field superintendent to supervise all work. In addition, an accountant is placed in the field to track all project construction costs and ensure expenditures stay within the project scope. During construction, bi-weekly field meetings are held to identify scheduling problems and correct them. Clients are encouraged to have a representative at these meetings and to participate in the resolution of scheduling problems (10).

Fatari stated that the main advantages of the design/build method include the following:

1. The ability to serve as the primary source of responsibility. The client is looking for someone to be

responsible for getting him what he wants and the design/build firm fills that need.

2. Because there is such a close interaction between the client and the project manager, there is a very high probability that the client's requirements will filter through a whole project. This is not always the case with conventional design-bid-construct methods.

3. A project can be completed in much less time than is required with the conventional method. Field construction can begin earlier because you don't lose four to six weeks while a project is out for bid (10).

Fatari said that if cost is the most important consideration, the design/build method could be a problem. He said that the design/build method is normally more expensive than the conventional design-bid-construct method, but quality control is greatly improved by design/build. He said the client has to make the decision of what is most important to him, low cost and control, or high quality and speed (10).

#### Comparison of the Three Private Sector Design/Build Methods

Table 3 is a comparison of the design/build methods used by Miller-Valentine; Huber, Hunt and Nichols; and The Austin Company. All three companies agreed that the key player in the design/build process is the project manager. He serves as the client's single point-of-contact, ensures that the facility will meet the client's requirements, is responsible for developing good rapport with the client,

**TABLE 3. A COMPARISON OF PRIVATE SECTOR  
DESIGN/BUILD METHODS**

FIRM	PROJECT MANAGER ASSIGNED	PROJECT IS DESIGNED	PROJECT IS BUILT	DESIGN/BUILD COMPARED TO CONVENTIONAL		
				QUALITY	TIME	COST
HUBER, HUNT AND NICHOLS	WHEN PROJECT IS STARTED	BY CONTRACT	STRUCTURAL IN-HOUSE  ALL OTHER BY CONTRACT	SIMILAR	FASTER	LESS
MILLER- VALENTINE	WHEN PROJECT IS STARTED	STRUCTURAL IN-HOUSE  ALL OTHER BY CONTRACT	STRUCTURAL IN-HOUSE  ALL OTHER BY CONTRACT	BETTER	FASTER	MORE
AUSTIN	WHEN CLIENT ACCEPTS PRELIMINARY DESIGN	IN-HOUSE	BY CONTRACT	BETTER	FASTER	MORE

establishes good lines of communication, and generally manages a project. Although the three companies agreed on most aspects of the design/build method, there were some glaring differences of opinion concerning the advantages and disadvantages of the process. Both Ronald Fatari of Austin, and Terry Hanauer of Miller-Valentine feel that the design/build method results in a much higher quality facility, whereas Warner Peck of Huber, Hunt and Nichols believes that facilities built using design/build are of similar quality to facilities constructed using the conventional design-bid-construct process, but are not of higher quality. Fatari and Austin both stated that the design/build method is more expensive than the conventional method, but that the time savings would make up for the additional costs. Peck found that the design/build method was less expensive than the conventional design-bid-construct method.

#### The Robins AFB Dining Facility, Robins AFB, Georgia

On the 26th of August 1986, the Robins Base Dining Facility (Bldg 166) burnt to the ground. This facility had served as the primary food service facility on Robins for both civilian and military personnel, and its loss made it impossible to provide adequate food service for the base. Air Force Logistics Command (AFLC) leadership recognized the need to replace this facility as quickly as possible, and directed the AFLC Deputy Chief of Staff for Engineering and

Services (AFLC/DE) to investigate ways to expedite the construction of a replacement. A criteria meeting was held on 22 September 1986 to discuss facility requirements and how to go about obtaining the new building. As a result of this meeting, it was decided that a "fast track" one-step design/build method would be used to acquire a new dining facility (26).

Personnel from the 2853 Civil Engineering Squadron (2853 CES) at Robins, with assistance from AFLC/DE staff members, were tasked with developing a project book as quickly as possible. A first draft was completed on 24 October 1986 and a review meeting was held on the 27th of October. The revision of the project book, based on the comments of the review meeting, was completed on 6 November 1986. This revised project book was used as the draft for the request for proposal (RFTP) to be used to solicit design/build proposals from prospective contractors. The final

RFTP was completed on 14 January 1987; the plan was to have a new facility within 18 months. Congress approved the project in January 1987 and it was advertised for bids on 2 February 1987 (26).

All contractor proposals were received by 14 March 1987 and the Army Corps of Engineers-Savannah District (COE-Savannah) distributed copies for review to Robins AFB, the Eastern Region Air Force Regional Civil Engineer in Atlanta (AFRCE-ER), and HQ AFLC. A selection board was convened on



27 April 1987 to select the best proposal. Selection was based on cost, quality, and technical expertise with points being awarded in each category. On 5 May 1987, the contract was awarded to Metric Construction. The Notice to Proceed was issued on the 13th of May (26).

This project was Metric's first experience using the design/build process. Metric, which is a construction firm, has no in-house design capabilities. Therefore, they subcontracted project design to Lockwood Greene, an A-E firm. Lockwood Greene had also never used the design/build method. Although both companies had good reputations, they had no experience working together. Metric's proposed schedule was to have facility construction completed by 23 April 1988, less than one year after contract award (26).

Metric started site preparation work in July, and Lockwood Greene submitted the preliminary drawings on 25 August 1987. During the design phase it became apparent that Lockwood Greene's inexperience with the design/build method would be a problem. They were accustomed to developing their designs as a total package; therefore, they did not necessarily start with a structural design or foundation design and complete it totally before they went on to the electrical and mechanical designs. This presented a problem because with the fast track design/build method the foundation designs were needed almost immediately, months before the electrical and mechanical designs were required. In addition, Lockwood Greene became frustrated

because they were receiving duplicate comments from the AFRCE-ER, the 2853 CES, HQ AFLC, and the COE. Lockwood Greene understood that the COE was to function as their single point-of-contact, and they found it difficult to "serve four masters." To compound the problem, Metric decided to pull the design of the electrical and fire protection segments out of the Lockwood Greene contract and award the design of these systems to another A-E without consulting Lockwood Greene. This made design coordination very difficult for Lockwood Greene, and also caused strained relations between their office and Metric (26).

Almost immediately after contract award, the facility user began requesting changes. All total, there were 12 user-requested changes, two of which were later cancelled. These changes were significant enough to disrupt design and delay construction completion. During the development of the RFTP, priority items were not identified in descending order. Thus, when the contract was negotiated, some critical items were deleted while other non-critical items were left in the project (26).

Construction of the project was continually being delayed because design drawings had not been approved. In addition, there were a number of instances where the contractor was working from drawings that had been revised and approved by the COE, whereas the Air Force construction inspector was using the old drawings to inspect the work. The flow of information from the contractor through the COE

to the Air Force was not always good. As a result the contractor became frustrated with what he perceived as continually changing guidance. The contractor did not have a project manager assigned as the single point-of-contact for this job. In addition, the government had not minimized the number of personnel who dealt directly with the contractor. Construction was finally completed on 3 November 1988, over six months after Metric's original projected completion date of 28 April 1988 (26).

When interviewed concerning the dining facility project, Ralph Butler, Construction Program Manager, HQ AFLC, stated that in his opinion the project was ill-suited for the design/build method. He said that the project was fairly complex, and since the government is a novice using the design/build method, it was very difficult to manage using the technique. Once the government has gained more experience with the design/build method it would probably not be too difficult to use with a project like a dining facility, but as one of the first design/build projects it was a poor choice. Adding to the difficulty was the fact that neither the general contractor nor the A-E firm who designed the project were experienced with the design/build process (4).

Butler felt that the biggest problem encountered during this project was the lack of a management plan that clearly defined who was responsible for each aspect of design and construction. Without such a plan, a number of things "fell

through the cracks" because the subcontractors believed they were the contractor's responsibility and vice versa. In addition, user requirements were not very well defined and there were a number of differences of opinion between Robins, HQ AFLC, and the COE, which were difficult for the contractor to resolve as to whose guidance to heed (4).

When questioned on time savings, cost savings, and quality, Butler said that in his opinion, due to the high level of interest in this project, it could have been completed just as fast using a conventional design-bid-construct method. He said the cost of the project was less than it would have been using the conventional method. The quality, although good, did not exceed that of a conventionally constructed facility (4).

In Butler's opinion, the biggest advantage of the design/build method is time savings, if it is used to construct a simple facility. However, he stated that this advantage was lost when constructing a complex facility. He felt the main disadvantage was the lack of design control. He said that in essence, the contractor is given a performance specification and as long as the his proposal meets the requirements of the RFTP, the client is obligated to accept the design. When asked if the design/build method should be used for future MILCON projects, Butler said that it should be used again. However, in his opinion, its use should be limited to less complex facilities such as office

buildings, warehouse or distribution facilities, and aircraft hangars (4).

Did the design/build process provide the facility at less cost and in a shorter period of time than the conventional MILCON process? According to the Automated Air Force Construction Pricing Guide in the Program, Design, and Construction (PDC) section of the Work Information Management System (WIMS), the estimated primary facility cost, not including support utilities, etc., of a 38,800 square foot dining facility, to be constructed over a 12 month period starting in June of 1987 at Robins AFB, is \$4,268,000.00 or \$110.00 per square foot. The actual primary facility construction cost for the dining facility was \$3,251,552.00 or \$83.80 per square foot; approximately 24 percent less than the construction cost predicted by the Pricing Guide.

Using the conventional facility acquisition process, the average MILCON project takes approximately four and a half years from identification of requirement to completion of construction. The Robins Dining Facility was completed 26 months after the original facility burned and 21 months after contract award. Despite the fact that the project was fraught with delays, it still took approximately 43% less time to complete than the average MILCON project acquired using the conventional method.

From these rough estimates it would appear that the Robins Base Dining Facility was completed in about half the

time, and at approximately 75 percent of the cost, as a similar project acquired using the conventional design-bid-construct method.

Lessons Learned. Lessons learned, compiled by HQ AFLC, COE, and AFRCE-ER personnel, on the Robins Base Dining Facility project included the following suggestions to improve the future use of the design/build method:

1. Include enough detail in the RFTP to make early design by the low bidder feasible.
2. Have the items in the RFTP prioritized to ensure critical items are not eliminated during bid negotiations.
3. Research the working relationship between the contractor and the A-E, and assign point value based on proven capability to work as a team. Significant quality points should be assigned to a bidder's organization, management staff, design and construction staff, and past performance.
4. Once the winning proposal is selected, hold a face-to-face conference with the successful bidder to reach an agreement on the detailed documentation for the project.
5. Minimize the number of parties who will deal directly with the contractor.
6. Minimize the number of user requested construction changes (26).

The AFCC Headquarters Facility, Scott AFB, Illinois

When bids for the AFCC Headquarters Facility, a Fiscal Year 1985 MILCON project, came in over \$5 million higher than the government estimate for the second time, AFCC decided that an alternative contracting method would have to be used in order to obtain the facility. AFCC had first advertised the project for bids in 1985, and at the time had estimated the project cost to be \$17.8 million. When the bids were opened in August 1985, the low bid was \$29.1 million, over \$10 million above the government estimate. AFCC withdrew the project from bid, redefined its scope, increased the government estimated cost to \$18.7 million, and again solicited bids. When bids were opened in January 1986, the low bid was \$24.4 million, still over \$5 million above the government estimate (2).

In early 1986, with funding for the project appearing to be in jeopardy, it was decided to attempt to complete the project using the design/build method. An A-E firm, 3D-I, was hired to develop an RFTP. Because time was critical, 3D-I was given only 90 days to develop a proposal. To expedite proposal development, 3D-I took the basic features from the original design and used them to develop a 20 to 30 percent design package. In addition, 3D-I spent one full week conducting a charette at Scott AFB with key members of the HQ AFCC staff to define facility requirements. When the week was completed, 3D-I had developed a model of the proposed facility which was shown to the working level

managers. Within 15 days, the Commander of AFCC had approved the design. While developing the RFTP, 3D-I observed that the government required a greater level of control than private sector firms; they suggested that a greater level of detail was required in the RFTP so that a "not to exceed" cost could be received from contractors bidding the project. To accommodate this need, 3D-I developed the proposal to a 40 percent design (28).

The project was advertised for bids in the fall of 1986. Five proposals were received on the project and three of these were considered to be responsive. None of the contractors who had submitted proposals had bid on the project before. The contract was awarded to the J. S. Alberici Company of St. Louis, Missouri in January 1987 for \$17.5 million. Selection of the winning proposal was based on a management plan and the cost to complete the project as designed in the RFTP. In this manner, the contractors were saved the cost of doing any preliminary design work in developing their proposals. The proposals were evaluated on the basis of technical expertise, as well as cost, but cost was weighted most heavily. Alberici's bid was lowest, with their proposal ranked second on technical expertise. The proposal which ranked first in technical expertise was \$200,000 higher than the maximum contract cost authorized by Congress (28). Alberici, an experienced design/builder which had completed a number of design/build projects for Anheuser-Busch, Inc., subcontracted project design to the



Benham Group. The Benham Group is an A-E firm based in Oklahoma City, Oklahoma with a branch office in St. Louis. To ensure that the government's concerns and comments received proper attention, Alberici assigned an executive vice-president to serve as Project Manager for the project. As Project Manager, this vice-president became the government's single point-of-contact for all issues concerning this project (28).

The working relationship between Alberici and the Benham Group proved to be a major problem. The two firms had not worked together before, and although they both claimed to have dealt with design/build projects in the past, neither seemed to have a good understanding of how the process should work. Some of Benham's designs were completed at the St. Louis branch office and some at the main office in Oklahoma City. In many cases the two offices did not coordinate their efforts. As a result, some of the design work was not up to standards. Currently, complete designs have not been received for all portions of the project, and some of the designs that have been submitted have lacked definition. In addition, some of Benham's designs have been modified by Alberici because they are beyond the scope of the project, and could not be incorporated into facility construction at current contract costs (1).

The Army Corps of Engineers-Louisville District (COE-Louisville), who served as the government's construction

agent for this project, initially had some problems administering the effort. The COE is divided into two separate divisions which each handles a project when it is in a particular phase, either design or construction. The COE design division deals with A-E firms while they are designing a project, performing reviews to ensure the project design will meet the government's requirements. Once the project has been designed, and a general contractor has been awarded a contract to construct a facility, the COE construction division becomes responsible for the project. The construction division monitors construction and is responsible for processing construction change orders. The COE did not know to which division to assign a design/build project, deciding finally to give it to the construction division. The construction division, being used to processing construction changes, tried to actually design all changes themselves before turning them over to the Alberici. In actuality they should have been informing the general contractor of the change requirements, then the Benham Group should have been doing the designs. This confusion caused a number of delays until the COE finally assigned a design manager to the project, who simply made certain that all design changes were turned over to the contractor (28).

Actual project construction started in November 1937. The poor working relationship between Alberici and the Benham Group, and the COE's confusion in dealing with a

design/build project began to take its toll on the project schedule so that by the fall of 1988 the project was over four months behind schedule. Additionally, many AFCC personnel perceived that since the project was essentially being designed as it was being constructed, it could be changed at will, resulting in an almost continual list of user requested changes. Lastly, a total reorganization of the HQ AFCC staff exacerbated the problem by requiring over five months to coordinate the changes to the systems furniture design (1).

In an attempt to better control the project, AFCC formed a Facility Activation Task Force (FATF) in October of 1988. This group was headed by Michael A. Aimone, who was serving as the Assistant Deputy Chief of Staff, Engineering and Services for AFCC. Overseeing the completion of this project became a full time job for Aimone and his staff of between five and six people. Aimone served as the Air Force's spokesperson, dealing directly with the contractor. Aimone's group dealt directly with the CCE, ensuring that the Air Force's requirements were being satisfied, and conducted weekly meetings with representatives from each of the AFCC directorates to ensure the new facility was meeting their needs (15). In addition, the FATF generated a weekly activity report to keep all interested parties informed of the status of all aspects of the project. The FATF was instrumental in reducing confusion on this project by

eliminating user requested changes and serving as the spokesperson for the Air Force.

Currently, the HQ AFCC project is 97 percent complete. The projected completion date is 13 September 1989, approximately 6 months after the original completion date of 11 March 1989.

Aimone stated that the HQ AFCC project was not well suited for the design/build method because of the complexity of facility requirements, ie. security requirements, raised flooring throughout the whole facility, and the requirement for radio frequency shielding (also known as TEMPEST shielding). In addition, the fact that this project was a headquarters facility made it subject to very close scrutiny from upper level management. This coupled with the belief that many upper level managers had that with the design/build method the design could be changed as the facility was being constructed, made procurement via the design/build process much more time consuming to manage than a conventional design-bid-construct project (1).

According to Aimone, one of the biggest problems encountered on this project was finding out the status of the designs. Some of the designs were very poor and as a result some subsystems were basically designed by submittals. In other words, the contractor would submit materials to the Air Force for approval, without a specification or drawing to compare it with, and if the Air

Force approved the materials, the contractor proceeded with construction (1).

Aimone felt that the project had been completed in less time and at a lower cost than if it had been procured using the conventional design-bid-construct method, but he said that it would be difficult to quantify these savings. Although it is difficult to quantify the costs saved using design/build, the savings are evidenced by the fact that when the conventional method was used the contract could not be awarded because the bids all exceeded the maximum amount allowed by Congress. The facility constructed consists of two buildings, separated by an atrium, instead of the three buildings, separated by two atriums, originally designed using the conventional method. The design/build process allowed the contractor the latitude to propose a less costly facility which was below the Congressional limit (1).

According to Aimone, the main advantage of the design/build method is that it has the potential to get everyone working together in a short period of time. The biggest disadvantage he found was that undisciplined users can bring the process to a standstill. He said that quite often decision makers like to take time in making decisions concerning a project. With the design/build method decisions made one day are usually implemented the next, causing a great deal of concern for many decision makers. As a result, many decisions on this project were either delayed or changed after work had already begun causing

schedule delays. Aimone also stated that the COE was having trouble quantifying the quality of work because the contractor had not used AFR 88-15, Facility Design and Construction - Criteria and Standards for Air Force Construction, or COE guide specifications on the project, instead opting for "industry standard specs", making it difficult for the COE to compare the work to a specification (1).

When asked if he thought the design/build method should be used for future MILCON projects, Aimone said that it indeed should be used again. However, he said it should be considered a "tool in the tool box" and not a "cure-all." He said it should be used on projects that the design/build team has experience with- such as dormitories, warehouses and distribution centers -jobs the team has confidence in doing. In addition, he felt that it would be a good idea to use teams that have worked together before to ensure that a good working relationship, which is so essential to the success of the design/build process, exists. He also stated that it would be a good idea to collocate the government's spokesperson for a design/build project with the contractor to ensure the timely exchange of information and to facilitate good rapport between team members (1).

Elbert Tschoepe, Director of Logistics and Training, Central Region Air Force Regional Civil Engineer (AFRCE-CR) in Dallas, served on the committee that developed the design/build package for the HQ AFCC facility. When

questioned concerning the suitability of procuring this facility using the design/build method, Tschoepe stated that in his opinion the facility was too complex for the design/build process. He felt that the project complexity was the primary reason that the project was six months behind schedule. Tschoepe said that the project would have run smoother if it had been procured using the conventional design-bid-construct method, but that it would have slowed the whole process down. Even though the project is currently six months behind schedule, it is still ahead of where it would be if it had been obtained using the conventional method (28).

According to Tschoepe, the biggest advantage of the design/build process is greater user involvement. In the early stages of this project AFCC, Military Airlift Command (MAC), and Scott AFB personnel were heavily involved in defining the requirements for this facility, thus ensuring that their needs were being met up-front. Conversely, Tschoepe felt that the biggest disadvantage of design/build is a lack of user discipline. The user must understand that construction will be taking place very rapidly, and that any requested construction changes will delay the project (28).

Tschoepe believes that the design/build method has a place in MILCON procurement, but that it is not a panacea and should not be used for all projects. He said that it would be most effective if used for simple facilities, but

should not be used for multi-user facilities like a headquarters building (28).

Did the design/build process save time and money on the AFCC Headquarters Facility? Using the Automated Air Force Construction Pricing Guide to calculate primary facility construction costs, a 218,000 square foot multi-purpose administrative facility, which would be constructed over a 23 month period at Scott AFB beginning in October 1987, would cost \$16,132,000.00 or \$74.00 per square foot. The actual primary facility construction cost for the AFCC HQ Facility is approximately \$15,000,000 or \$68.80 per square foot. This is around seven percent less than the estimated Pricing Guide cost. However, this facility had many special requirements such as raised flooring and security systems which are not reflected in the Pricing Guide value of \$74.00 per square foot. In addition, when the project was let for bids using the conventional method, all bids were over \$24 million. Thus, although difficult to quantify, it appears that using the design/build method for this project may have been more economical than the conventional method.

From the time the RFTP was initiated in January 1987 until the projected project completion date in September 1989 is 33 months. With the average MILCON project acquired using the conventional method taking approximately 54 months, this project took about 38 percent less time to complete using the design/build method than if it had been procured using the conventional method. From these rough



calculations it appears that the HQ AFCC Facility was completed at a lower cost and in less time than it would have if it had been obtained using the conventional design-bid-construct process.

Lessons Learned. The lessons learned, compiled by the FATF, on the HQ AFCC project include the following:

1. Apply the design/build method selectively.
2. Identify all facility requirements up front.
3. Be prepared for the increased government expertise and time required to properly manage a design/build project.
4. Finish the design segments of the project before starting construction.
5. Ensure user discipline is exercised during the change order process.
6. Try to use teams that have worked together before, because the design/build method works best after a team has experience working together (2).

#### Summary of Findings for Air Force Design/Build Projects

Table 4 is a summary of the findings for the Air Force design/build MILCON projects at Robins AFB, Georgia and Scott AFB, Illinois.

**TABLE 4. A SUMMARY OF TWO AIR FORCE  
DESIGN/BUILD PROJECTS**

PROJECT	PROJECT SCOPE		TIME TO COMPLETE PROJECT	COMPARED TO CONVENTIONAL METHOD		
	COST	SIZE		QUALITY	TIME	COST
ROBINS AFB DINING FACILITY	\$3,251,552	38,800 SF	26 MONTHS	SIMILAR	43% LESS	24% LESS
AFCC HQ FACILITY, SCOTT AFB	\$15,000,000	218,000 SF	33 MONTHS	SIMILAR	38% LESS	SIMILAR

#### IV. Conclusions and Recommendations

##### Overview

The purpose of this case study was to evaluate the design/build method used by private sector firms and to study the application of the method to Military Construction Program projects. This conclusion presents the management methods, strengths and weaknesses of the design/build method used by the Austin Company; Huber, Hunt and Nichols; and the Miller-Valentine Group. In addition, the effectiveness of the design/build method used by the government for the Base Dining Facility at Robins AFB and the AFCC Headquarters Facility at Scott AFB was examined. Recommendations are then provided concerning the future use of the design/build method for Military Construction Program projects. The conclusions and recommendations presented in this chapter are based on the interviews, data from management information systems and on-site observations of the design/build projects.

##### Conclusions

The successful application of the design/build method by the Austin Company; Huber, Hunt and Nichols; and the Miller-Valentine Group demonstrates that the technique is very effective in reducing the time required to construct a facility. Although the use of the design/build method for the Robins Base Dining Facility and the AFCC Headquarters

Facility was not without problems, the technique saved time and was no more expensive than the conventional method. The following discussion summarizes the steps used by the civilian firms for design/build construction. The strengths and weaknesses of the design/build method as perceived by the civilian firms are included in this dialogue. This is followed by a discussion of the design/build method used by the Air Force for the MILCON projects at Robins AFB and Scott AFB. The problems encountered using the technique and a discussion of the type of facility best suited for procurement using the design/build method are also included.

The Private Sector Method. The three private sector design/build firms interviewed all used similar methods in managing design/build projects. The first step for all three firms was the identification of the user's requirements and the development of a proposal to meet these needs. The key player for all three firms is the project manager. The project manager serves as the client's single point-of-contact for a project and is responsible for ensuring that the client's needs and desires are being addressed. Although each of the three firms goes about design and construction in a different manner, the only person that the client has to deal with during any phase of a project is the project manager.

All three of the design/build firms interviewed felt that it was crucial that the client have an individual represent them throughout a project. This representative

should be knowledgeable of the company's operations and needs, and have the authority to make decisions on a project. The lack of such a representative, or continually changing the individual in the position, is detrimental to the flow of information and can cause project delays due to a constant stream of construction changes requested by different members of the client's staff.

The three firms all agreed that the design/build method is used in the civilian sector because it is much faster than the conventional design-bid-construct method. However, the firms did not agree on the cost of constructing a facility using the design/build method. Two firms felt that design/build construction was actually more expensive than the conventional method. The third firm, Huber, Hunt and Nichols, stated that the design/build method was more inexpensive than conventional construction for simple projects such as warehouses and distribution centers. However, Huber, Hunt, and Nichols has only used the design/build method for simple, straight-forward projects, whereas Miller-Valentine and Austin have used the method for a wide variety of facilities.

The Air Force Method. The design/build method used by the Air Force is slightly different from the technique used in the private sector. For both the Robins Dining Facility and the AFCC Headquarters Facility, the Air Force developed a Request for Technical Proposal (RFTP) which represented a design of approximately 30 percent. The dining facility

proposal was developed by personnel at HQ AFLC and Robins AFB, whereas the headquarters facility proposal was developed by an A-E firm. The RFTP's were used to solicit proposals from contractors, and in both cases the contracts were awarded on the basis of cost and technical expertise.

The Robins Dining Facility project had problems initially because the user began requesting construction changes almost immediately after contract award. This resulted because the user did not have a knowledgeable representative involved in the contract negotiations, and a number of items essential to his operation were deleted from the project without protest. In addition, there was confusion during design and construction as to who should be contacted with concerns or questions on the project. This confusion was due in part to the fact that the contractor had not appointed a project manager to serve as the point-of-contact for the Air Force, and as a result different individuals within the contractor's design/build team were dealing with the government without coordinating with each other.

Information flow for the AFCC Headquarters Facility project was better than for the Robins project because the contractor, J. S. Alberici, had a vice-president as the point-of-contact for the government. However, user-requested construction changes were causing long delays in the construction schedule until the Facility Activation Task Force (FATF) was formed by HQ AFCC to manage the project and

serve as the user's representative in dealing with the contractor. With the formation of the FATF, all change requests had to be processed through them and the number of changes was greatly reduced. In addition, with the FATF serving as the Air Force's representative on the project, the flow of information between the government and the contractor greatly improved.

Both projects were completed in less time than it would have taken to complete them using the conventional method. However, both projects took approximately six months longer than had originally been projected. The delays were due primarily to a lack of experience using design/build methods by both the government and the contractors. In both cases, the general contractors had never dealt with the A-E firms who were subcontracted to perform the project designs. The lack of a good working relationship between contractor and A-E caused many delays in the design process for both projects, and in some cases caused the final designs to be completed by contract submittals. The lack of experience on the part of the government caused some confusion over who should be performing certain tasks. The Army Corps of Engineers had some difficulty in determining which of their divisions was responsible for the review of project designs. In addition, the responsibilities of base level civil engineering personnel were not well-defined, which caused some turmoil. The cost of construction for the Robins Dining Facility was about 24 percent less than it would have

been if it had been constructed using the conventional design-bid-construct method. The AFCC Headquarters Facility design/build construction cost was similar to what it would have been using the conventional method. The project had originally been programmed using the conventional method and the job had been advertised for bids twice. Both times the low bidder was several million dollars above the programmed project cost and the contract could not be awarded. It was because of this failure to award a contract that the design/build method was finally used. The design/build method gave the contractors bidding the project sufficient latitude to present proposals that were below the maximum contract cost and allowed the Air Force to award the contract.

Future Use of Design/Build for MILCON. The design/build method has proven that it can effectively deliver facilities in much less time, and in some cases at a lower cost, than the conventional design-bid-construct method. However, it is not a panacea and should not be considered the only method to improve the MILCON process. Part of the problems and delays encountered with the dining facility and the headquarters building were the result of the complexity of the projects. The design/build method seems to be best suited for simple projects such as basic hangars, warehouses, temporary living quarters, simple administrative facilities and distribution centers. It appears that the lack of experience of those involved in the



two projects was a confounding factor in delaying project completion. It is also possible that as Air Force personnel, as well as contractors and A-Es, become more experienced in applying the technique, more complex projects will become as easy to manage using the design/build method as simple projects.

### Recommendations

This final section presents recommendations for the future use of the design/build method for other MILCON projects. These recommendations are based on the research findings of this study. The relevancy of the design/build methods used on the Robins AFB Dining Facility and the AFCC Headquarters Facility are evaluated with respect to their applicability to other MILCON projects.

1. The Air Force should continue the use of the design/build method for MILCON projects. However, the technique should be applied selectively to fairly simple projects. The application of the design/build method to complex projects should be delayed until government personnel have had more experience with the technique and are more familiar with its unique requirements.
2. Ensure that the contractor and A-E comprising the contractor's design/build team have worked together before and are both familiar with the design/build process. The lack of a good working relationship between the contractor and the A-E was the biggest problem encountered for both the

Robins AFB and the Scott AFB projects. Also ensure that the contractor assigns a project manager to serve as the point-of-contact for the Air Force. A single point-of-contact is essential for the effective exchange of information between the Air Force and the contractor.

3. Try to assign one individual to serve as the Air Force's point-of-contact for the entire project. Numerous problems result if the user's point-of-contact is continually changing. The individual selected should be knowledgeable of the organization's missions and requirements and have the authority to make decisions on a project to ensure that the schedule is not delayed while the contractor awaits a decision from the user.

4. Ensure all user requirements are identified up-front and that the user exercises discipline during the construction change order process. Poorly defined user requirements and a constant "barrage" of user requested changes caused major delays and increased costs on both projects.

5. Ensure that all members of the design/build team understand the requirements of the design/build process and understand their part in the process. Problems were encountered on both projects examined in this study because there was confusion over who was responsible for performing certain tasks.

6. The lessons learned that are being compiled for MILCON design/build projects need to be given the widest possible dissemination. Understanding the problems encountered with

the technique in the past is critical to ensuring that the same mistakes are not made over and over again. The problems encountered with the design/build method for the MILCON projects examined in this case study were identical in a number of instances. Unless these problems are shared with the rest of the Air Force construction community, it is likely they will occur again in future design/build MILCON projects.

7. As more design/build MILCON projects are completed, a quantitative analysis should be performed to determine if the design/build projects are completed in less time and at a lower cost than projects procured using the conventional design-bid-construct method.

Table 5 provides a summary of these issues and items that must be considered when applying the design/build method to MILCON projects.

#### Summary

This case study of the design/build method examined the technique used by civilian firms and the results of the application of the method to two Air Force MILCON projects. The design/build method has been used in the private sector to procure quality facilities in much less time than is required using the conventional design-bid-construct method. The design/build method was used successfully by the Air Force to procure MILCON facilities at Robins AFB and Scott AFB in less time than would have been required using the

**TABLE 5. A SUMMARY OF FINDINGS ON THE USE OF  
DESIGN/BUILD METHODS FOR MILCON PROJECTS**

- 1. USE THE DESIGN/BUILD METHOD SELECTIVELY.**
- 2. IDENTIFY FACILITY REQUIREMENTS UP-FRONT.**
- 3. ASSIGN ONE INDIVIDUAL TO SERVE AS THE AIR FORCE'S REPRESENTATIVE FOR THE DURATION OF A PROJECT.**
- 4. GIVE THE REPRESENTATIVE SUFFICIENT AUTHORITY TO MAKE DECISIONS ON A PROJECT.**
- 5. ENSURE THAT THE CONTRACTOR AND A-E COMPRISING THE DESIGN/BUILD TEAM HAVE A GOOD WORKING RELATIONSHIP.**
- 6. ENSURE USER DISCIPLINE IS EXERCISED IN REQUESTING CONSTRUCTION CHANGES.**
- 7. ENSURE ALL MEMBERS OF THE DESIGN/BUILD TEAM UNDERSTAND THE PROCESS AND THEIR ROLE IN IT.**

conventional method. The successful use of the design/build method for the Robins AFB and Scott AFB projects makes the technique a viable alternative in procuring future MILCON projects.

Appendix A: Personal Interview Questionnaire

The following form was used for personal interviews with representatives from the Austin Company, Cleveland, Ohio; Miller-Valentine Group, Dayton, Ohio; and Huber, Hunt and Nichols, Inc., Indianapolis, Indiana. The responses are incorporated in the research findings.

QUESTIONNAIRE # \_\_\_\_\_

INTERVIEWEE:

POSITION:

JOB:

DATE:

TIME:

LOCATION:

1. What is the size of your firm?
2. Do you handle conventional construction contracts in addition to design/build? If so, what percentage of your work is design/build?
3. How much design/build work (in dollars) did you do last year?
4. How long have you been doing design/build?
5. Do you specialize in any type of facility, and if so what type?
6. Explain the steps involved in the design/build process.
7. What is the client's role in your process?
8. What do you feel are the advantages of design/build compared to conventional design-bid-construct procedures?
9. What are the disadvantages of design/build?

Appendix B: Personal Interview Questionnaire

The following form was used for all personal interviews with Construction Program Managers at Headquarters, Air Force Communications Command, Scott AFB, Illinois; Headquarters, Air Force Logistics Command, Wright-Patterson AFB, Ohio; Robins AFB, Georgia; and Scott AFB, Illinois. The responses are incorporated in the research findings.

QUESTIONNAIRE # \_\_\_\_\_

INTERVIEWEE:

POSITION:

JOB:

DATE:

TIME:

LOCATION:

1. What was the size of the design/build project you managed (square feet and dollars)?
2. Would you classify the project as complex? Was the project well suited for design/build? Why or why not?
3. Was the contractor experienced with design/build construction?
4. Explain the steps in the design/build process used for your project.
5. What problems did you encounter using the design/build process? How could these problems be avoided in the future?
6. Was the project completed in less time and at a lower cost than it would have been had it been accomplished using the conventional design-bid-construct method?
7. What do you feel are the advantages of design/build?
8. What do you feel are the disadvantages of design/build?
9. Do you think design/build should be used for other MILCON projects? If so, what type?

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## VITA

Captain William W. Buckingham was born on 11 July 1948 in Dodgeville, Wisconsin. He graduated from Mineral Point High School, Mineral Point, Wisconsin in 1966 and enlisted in the Air Force in 1969. In 1980 he was selected for the Airman's Education and Commissioning Program and attended the University of Colorado at Denver where in December 1982 he received the Bachelor of Science degree in Electrical Engineering. He attended Officer's Training School (OTS) where he was commissioned a second lieutenant on 22 April 1983. After completing OTS, Captain Buckingham was assigned to the 2750th Civil Engineering Squadron, Wright-Patterson AFB, Ohio where he worked as an electrical design engineer and later, as the Chief of the Environmental Planning Section. He was reassigned to HQ AFLC in October 1985, where he served as the civil engineering representative in the Logistics Management Systems Modernization Program Site Activation Support Office. In June 1987, he became the Robins AFB Construction Program Manager for the HQ AFLC Deputy Chief of Staff for Engineering and Services and remained in that position until entering the School of Systems and Logistics, Air Force Institute of Technology, in June 1988.

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## Abstract

In recent years, Air Force senior leadership has become concerned with the use of the conventional design-bid-construct acquisition process for Military Construction Program (MILCON) projects. The process is slow and often very expensive. In an effort to improve the MILCON process, the Air Force has been testing the design/build acquisition method. This case study examines the design/build method used by three private sector contracting firms, and looks at the results of the application of the design/build method to two Air Force MILCON projects. The research objectives were to study the steps involved in the design/build methods used in the private sector and compare them to the method used by the Air Force and to determine if the method was effective if reducing the time and costs required for MILCON projects.

The results showed that the design/build method used by private sector firms is effective in reducing the time required to construct a facility. However, the cost of constructing a facility using design/build can actually be higher than if it were built using the conventional method.

The results also indicated that the design/build method used by the Air Force is very similar to the method used in the private sector. Use of the method reduced the time required to complete the Robins AFB Dining Facility at Robins AFB, Georgia and the AFCC Headquarters Facility at Scott AFB, Illinois. The cost for Robins project was significantly less; however, the cost of the Scott project was similar to what it would have been if the conventional method had been used. The results also showed that the use of the design/build method should be restricted to the construction of simple, straight-forward projects until government personnel become more familiar with the process.

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